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PROFITABILITY AND PRODUCTION FUNCTION OF SMALL SCALE IRRIGATED TOMATO PRODUCTION IN NIGER STATE, NIGERIA

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ABSTRACT
This study investigated profitability and production function of irrigated tomato production among small scale farmers in Niger State. Data used for the study were obtained using structured questionnaires administered to 100 randomly selected irrigated tomato farmers from Kontagora and Wushishi Local Government Areas of the state. Descriptive statistics, gross margin, production function analysis and resource-use efficiencies were used for analysis of the data obtained. The result showed that irrigated tomato production is profitable in the area with net farm income of ₦85306.92 per hectare. Estimated multiple regression analysis revealed that semi-log regression chosen as the lead equation. The R^2 value was 0.757. Farm size (X_1), quantity of seed (X_4) and agrochemical (X_5) are the significant factors influencing output level of irrigated tomato at 1 % level of probability. Labour is also a significant factor at 5 % level of probability. Estimated efficiency-ratio (r) showed that the resources were not efficiently utilized. Estimated elasticity of factor inputs and return to scale showed that there is increasing return to scale. It was therefore recommended that loans and credit facilities should be provided for irrigated tomato farmers in the area. Similarly, dams should be constructed and irrigation equipments be provided for the farmers in the area to supply water for irrigation of farmland. Also, extension agents should be provided to disseminate research findings to irrigated tomato farmers on modern technology.

KEYWORDS: Profitability, production function, irrigated tomato

INTRODUCTION

Tomato (*Lycopersicon esculentum*) is one of most cultivated vegetable in most regions of the world, ranking second in importance to potatoes (*solanum tuberusum*) in many countries. Although tomato origin and early history of its domestication are obscure, the weight of evidence suggested that tropical America and Mexico were probable centre of origin. African tomato varieties introduced to Africa and Nigeria in particular at the end of the 19th century.

Production of tomatoes is increasing in most regions of the world, brought about by increased hectarage subsequently increased yields. In 2004, tomato assumed the position of one of the most important fruits in terms of worlds' vegetable produced. Furthermore, in Nigeria, about 88900 metric tones were produced in 2004 (FAO, 2005). Tomato (*Lycopersicon lycopersicum*) is perhaps the most important popular vegetable crop grown all over the country. Both the wet and dry season cropping system contributes immensely to the national requirement. But the bulk production is from the dry season cropping system grown yearly under irrigation in southern states.

In Nigerian cities and their suburbs, tomato is used in foods almost every day in fresh, dry or processed form. In industry, tomato is processed into paste, puree, sauce, ketchup of tomato juice. Tomato production in Nigeria is seasonal and consequently, its supply for home and industrial use is seasonal with a peak during harmattan season. The seasonality of supply affects price. For example, 1 kg of fresh tomatoes in Jan/Feb. at Sokoto cost less than N10.00; the same quantity sells for about N57.00 in June (SADP, 1995). Tomato is an important source of vitamins A and C in human nutrition. Plant carotenoids, which represent the major pigment in tomato fruit are the primary dietary source of vitamin A. A medium sized tomato (5.3

oz) contains 35 calories, is rich in vitamin C, vitamin A, potassium, and fiber (Hector et al., 2002). The fruit of tomatoes are eaten raw or cooked. Large quantities of tomatoes are used to produce soup, juice, sauce, ketchup, puree, paste and powder. They are extensively used in the canning industry. Green tomatoes are used for pickes and preserves.

Usually, production or harvesting, storage, weather or major crop diseases can seriously disrupt tomato production and marketing or consumption pattern. Therefore, there is need to examine the profitability and production function of irrigated tomato production in Niger State in order to answer some important questions like how profitable is irrigated tomato production?, what are the determinants of cowpea production in the study area? how efficiently are the farmers utilizing their resources in order to maximize their output and keep pace with the demand of the ever increasing population?.The specific objectives of this study are to: (a) identifying the socio-economic characteristics of the irrigated tomato farmers; (b) estimate the profitability of irrigated tomato production in the study area; (c) determine factors affecting irrigated tomato production; (d) determine the efficiency of resource-use in irrigated tomato production in the study area.

METHODOLOGY

Study Area: The study was conducted in Niger State of Nigeria. The state is located within latitudes 8^o – 10^o north and longitudes 3^o – 8^o east of the prime meridian with land area of 76,363 square kilometers and a population of 4,082,558 people (Wikipedia, 2008). The state is agrarian and well suited for production of arable crops such as cowpea, yam, cassava and maize because of favourable climatic conditions. The annual rainfall is between 1100mm – 1600mm with average monthly temperature ranges from 23^oC and 37^oC (NSADP, 1994). The vegetation consist mainly of short consist mainly of short grasses, shrubs and scattered trees.

Sampling Techniques: The data mainly from primary sources were collected from two Local Government Areas (LGAs) which were purposively selected because of prevalence of the crop in the area using multistage sampling technique. The LGAs include Kontagora and Wushishi LGAs. The second stage involved a simple random selection of 50 farmers from each of the two LGAs, thus, making 100 respondents. The data were collected with the use of structured questionnaire designed in line with objectives of the study.

Data Analysis

Descriptive Statistics: The method employs arithmetic mean, frequency distribution, percentage etc. The technique was used to group and summarize the data obtained from the field.

Gross margin: This is the difference between the Gross Farm Income (GFI) and the Total Variable Cost (TVC). It is a useful planning tool in situations where fixed capital is negligible portion of the farming enterprises in the case of small scale subsistence agriculture (Olukosi and Erhabor, 1988).

GM = GFI – TVC

Where GM = Gross Margin, GFI = Gross Farm Income, TVC = Total Variable Cost.

Gross margin analysis is one method of calculating profitability of small scale cropping enterprises (Olukosi *et.al*, 2006).

Gross ratio: This is is a profitability ratio that measures the overall success of the farm. The lower the ratio, the higher the return per naira.

$$GR = \frac{TFE}{GI}$$

Where GR = Gross Ratio, TFE = Total Farm Expenses and GI = Gross Income.

Operating Ratio: The operating ratio is directly related to the farm variable input usage. The lower the ratio, the higher the profitability of the farm business.

$$OR = \frac{TOC}{GI}$$

Where OR = Operating Ratio, TOC = Total Operating Cost and GI = Gross Income.

Return on Capital Invested: This is defined as gross margin divided by total variable cost.

$$RI = \frac{GM}{TVC}$$

Where RI = Return on Capital Invested, GM = Gross Margin and TVC = Total Variable Cost

Table1: Socio-economic Characteristics of Sampled Farmers.

Variables.	Frequency	Percentage
Sex		
Male	79	79
Female	21	21
Marital Status		
Single	19	19
Married	89	89
Divorced	0	0
Widow(er)	2	2
Age (years)		
21 – 30	26	26
31 – 40	26	26
41 – 50	25	25
51 – 60	13	13
60 – 70	6	6
>70	4	4
Education		
No Formal Education	62	62
Primary	27	27
Secondary	11	11
Tertiary	0	0
Household Size		
1 – 10	81	81
11 – 20	19	19
Years of Farming Experience		
1-5	81	81
6-10	13	13
11-15	3	3
16-20	3	3
Means of Land Acquisition		
Owned	73	73
Gift	6	6
Family	0	0
Rented	2	2
Inherited	19	19

Source: Field survey, 2008

Production Function Analysis: Regression model was used to examine input-output relationship and the implicit form of the model is given by:

$$Y = f(X_1, X_2, X_3, X_4, X_5 U_i) \quad (1)$$

Where Y = Output from Cowpea Production (Kg)
X1 = Farm Size (ha)
X2 = Quantity of Seeds (Kg)
X3= Quantity of fertilizer (Kg)
X4 = Labour Input (Manday)
X5 = Agrochemical (Liters)
U = Error term.

The explicit form of this function takes the following forms:

$$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + U_i (linear) \quad (2)$$

$$Y = a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + U_i (semi \log) \quad (3)$$

$$\ln Y = a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + U_i (double \log) \quad (4)$$

$$\ln Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + U_i (\exp onential)$$

Table 2: Estimated Gross Margin Analysis for Irrigated Tomato Production

Variables	Mean cost(₦)/hectare	% of Total cost
Transport cost	989.61	2.49
Seed cost	752.45	1.89
Fertilizer cost	7,988.45	20.06
Agrochemical cost	5961.65	14.87
Hired labour cost	18214.10	45.75
Gift	3605.39	9.06
Total variable cost (TVC)	37511.65	94.21
Fixed Cost		
Watering can(Depreciation)		
Farm tools (Depreciation)	730.50	1.84
Total Fixed Cost		
Total Cost	1573.16	3.95
	2303.66	5.79
Gross income (GI)	39815.31	100
Gross margin (GM)		
Net Farm Income		
Returns on Naira	125122.23	
Invested	87610.58	
Operating Ratio	85306.92	
Gross Ratio	2.34	
	0.27	
	0.32	

Source: Field survey, 2008

Efficiency of Resource-use: This was determined by the ratio of marginal value product (MVP) to marginal factor cost (MFC) of inputs based on the estimated regression coefficients. Following Rahman and Lawal (2003) and Iheanacho et al (2003) efficiency of resource (r) is given as

$$r = \frac{MVP}{MFC} \qquad (6)$$

The rule provides that when r = 1, there is efficient use of resource; r > 1 and r < 1 indicate underutilization and overutilization of a resource respectively. The values of MVP and MFC were estimated as follows:

$$MVP = MPP \bullet P_Y$$

$$MFC = Px_i$$

Where MVP = Marginal Value Product of variable input;
MPP = Marginal Physical Product;
Py = Unit Price of output;
Px_i = Unit Price of input Xi
r = Efficiency ratio.

Economies of Scale: This is the measure of farm's success in producing maximum output from a given set of inputs. The elasticity of production (Ep) and return to scale (RTS) was estimated using the formula

$$\sum^{k} Epx_i = RTS$$

RESULTS AND DISCUSSION

Socio-economic characteristics of sampled farmers: Some socio-economic characteristics may influence irrigated tomato in the area. The variables analyzed in this study include sex, marital status, age, education, household size, years of farming experience and means of land acquisition.

Table1 shows that majority of the respondents (79%) were males. This is a manifestation of gross inequality in gender distribution and calls for concerted effort in empowering the women to contribute their own quota to production in the study area. It is also shown in the table that 51% of the sampled farmers were between the ages of 30 and 50 years. Thus, majority of the sampled farmers were middle aged, which could result in a positive effect on production. The modal class of educational level of respondents was non-formal education (62%) followed by Primary (27%) and secondary (11%) education. This is not surprising outcome as the study area falls within educationally disadvantaged states of Nigeria. Table1 also showed that 81% of the farmers had less than 10 family members while 19% had 11 to 20 members. Generally, in agrarian settlements, a large family size guarantees free and cheap labour. The table revealed that 81% of the farmers were within the range of 0-5 years farming experience, while 19% had 11years and above farming experience.

Table 3: Estimated semilog production function (lead equation)

Variables	Regression coefficients	T value
Farm size (X_1)	3091.385	7.841***
Labour (X_2)	391.478	2.390**
Fertilizer (X_3)	175.968	0.777^{NS}
Quantity of seed (X_4)	-3468.561	-4.003***
Agrochemical (X_5)	35688.293	4.451***
Constant	-84747.9	-4.366***
R^2	0.757	
F ratio	58.471***	

Source: Field survey, 2008

*** Significant at 1 % level of probability, ** Significant at 5 % level of probability, NS Not significant

Gross Margin Analysis of Cowpea Farmers: The estimated gross margin analysis for irrigated tomato farmers is shown in Table2. The table showed that cost of hired labour constituted 45.75 percent of the total cost of production in irrigated tomato farming followed by fertilizer and agrochemical with 20.06 and 14.87percents respectively. A confirmation of profitability of irrigated tomato production is shown by a net income of ₦85306.92. Also, the return on a naira invested was ₦2.34 while gross and operating ratios were 0.32 and 0.27 respectively. All the ratios were less than 1 indicating profitability of the farming.

Table 4: Estimated efficiency ratio (r)

Variables	MPP	MVP	MFC	Efficiency ratio
Farm size (X_1)	-30032.39	-1126214.97	1000	-1126.2
Labour (X_2)	102.22933	3833.5999	400	9.584
Quantity of seed (X_4)	-167052.4112	-6264462.42	325	-19275.3
Agrochemical (X_5)	14805.19513	555194.82	916.7	605.6

Source: Field survey, 2008

Production function Analysis: The production function that was used to determine the nature of inputs – output relationship in irrigated tomato production is shown in Table 3 (Semilog production function as the lead equation). The value of coefficient of determination (R2) indicated that about 75.7 % of variation is explained by the inputs included in the regression model (Table 3), while the remaining 24.3 % is as a result of non-inclusion of some explanatory variables as well as other factors outside the control of the farmer. The regression coefficients of farm size (X1), labour (X2), fertilizer (X3) and agrochemical (X5) are positive indicating that an increase in each of these variables would lead to an increase in the level of of irrigated tomato produced. Conversely, the regression coefficient of seed (X4) is negative indicating that a unit increase in this input would lead to a decrease in the level of of irrigated tomato produced.. Table 3 also showed that farm size (X1), quantity of seed (X4), agrochemical (X5) and labour (X2) were significant at 1 % levels of probability while labour is significant at 5 % level of probability.

Resource-use Efficiencies: The efficiency indicator in Table 4 revealed farm size(X_1) and quantity of seed(X_4) were over-utilized while labour (X_2) and agrochemical (X_5) were under-utilized.

Elasticity of production inputs and returns to scale: The inputs elasticities of production is shown in Table 5. The summation of the elasticities of 11.381 obtained indicated an increasing return to scale and that irrigated tomato production was in stage I of the production region.

Table 5: Estimated elasticity of factor inputs and return to scale

Variables	Coefficient of elasticity of production
Farm size (X_1)	0.981
Labour (X_2)	0.124
Fertilizer (X_3)	0.056
Quantity of seed (X_4)	-1.100
Agrochemical (X_5)	11.32
Return to scale	11.381

Source: Field survey, 2008

SUMMARY AND CONLUSION

This empirical study is on profitability, and production function of small scale irrigated tomato production in Niger State. The study showed that irrigated tomato production was profitable with a net income of ₦85306.92 per hectare. It was revealed from the production analysis that farm size (X_1), quantity of seed

(X_4) and agrochemical (X_5) were the significant factors influencing output level of irrigated tomato production at 1 % level of profitability. While the estimates of the returns to scale obtained indicated an increasing returns to scale, irrigated tomato farmers were not efficient in the use of their production resources.

RECOMMENDATIONS

Based on the findings above it is therefore recommended that loans and credit facilities should be provided for irrigated tomato farmers in the area. Similarly, dams should be constructed and irrigation equipments be provided for the farmers in the area to supply water for irrigation of farmland. Finally, extension agents should be provided to disseminate research findings to irrigated tomato farmers on modern technology.

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